

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of:

Implementing Public Safety Broadband)	PS Docket No. 12-94
Provisions of the Middle Class Tax Relief)	
and Job Creation Act of 2012)	
)	
Implementing a Nationwide, Broadband,)	PS Docket No. 06-229
Interoperable Public Safety Network in the 700)	
MHz Band)	
)	
Service Rules for the 698-746, 747-762, and)	WT Docket No. 06-150
777-792 MHz Bands)	

COMMENTS OF HARRIS CORPORATION

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Table of Contents

I. SUMMARY.....	2
II. THE COMMISSION’S TECHNICAL SERVICE PARAMETERS MUST PROVIDE FIRSTNET AND COMMERCIAL STAKEHOLDERS WITH THE CLEAR GUIDANCE AND REGULATORY CERTAINTY THAT WILL DRIVE DEVELOPMENT OF AN INTEROPERABLE PUBLIC SAFETY NETWORK.....	4
A. A Unified Set of Technical Requirements for the Expanded Public Safety Broadband Spectrum is Essential.	4
B. The Commission Must Prioritize Adjacent Interference Protection.....	5
III. THE COMMISSION MUST ADDRESS NEAR-TERM PUBLIC SAFETY ISSUES IN BOTH NARROWBAND AND BROADBAND SPECTRUM.	6
A. The Commission Should Allow Equipment Certified Under the Waiver Order’s Requirements To Operate on Early Build Out Systems In The Expanded Public Safety Broadband Spectrum.	7
B. The Public Safety Spectrum Act Obligates The Commission To Address All Issues Related To Incumbent Operations In The Affected Bands.	8
C. 700 MHz Narrowband Spectrum Will Be Needed for Voice Communications For Years to Come.	9
IV. A SET OF CLEARLY-DEFINED STATIONS AND CLASSES WILL ENSURE THE COMMISSION’S ABILITY TO DEVELOP A UNIFIED SET OF TECHNICAL RULES.	10
A. The Commission Should Define Base Stations in Accordance with 3GPP Standards.....	10
B. Mobile and Immobile Station Definition Recommendations.	12
V. SPECIFIC RECOMMENDATIONS FOR TECHNICAL SERVICE RULES.....	13
A. The Public Safety Guard Band Evolution.....	14
B. Power Limits Should Not Be Governed By Population Density.....	14
C. Portable Device Power Limits Higher Than Those Established For Commercial LTE are Appropriate.....	15

D. Harris Supports the Proposed Power Flux Limit Consolidation.....	17
E. Emission Limits Should Be Consolidated and Carefully Designed Around Unique Interference Concerns in This Band.....	19
F. Field Strength Limits	21
VI. CONCLUSION.....	22
Addendum A.....	23

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COMMENTS OF HARRIS CORPORATION

Harris Corporation (Harris) respectfully submits these comments in response to the Federal Communications Commission’s (Commission) Notice of Proposed Rulemaking to implement a nationwide public safety broadband network (NPSBN) in the 700 MHz band in accordance with provisions of the Middle Class Tax Relief and Job Creation Act of 2012 (“Public Safety Spectrum Act” or “Act”).¹ Harris lauds the Commission for taking this action to expedite the development of the NPSBN and the technologies that will operate thereon, and urges swift and thorough resolution of key matters that will enhance first responder communications nationwide.

¹ See In the Matter of Implementing Public Safety Broadband Provisions of the Middle Class Tax Relief and Job Creation Act of 2012, PS Docket No. 12-94; Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229; Service Rules for the 698-746, 747-762, and 777-792 MHz Bands, WT Docket No. 06-150, rel. Mar. 18, 2013 (NPSBN Service Rules NPRM).

I. SUMMARY.

Harris urges the Commission to provide clear guidance and distinct definitions of key components of the NPSBN in its service rules for the expanded public safety broadband spectrum. A primary focus of these rules must be on the protection of first responders operating narrowband and broadband mobile stations in 700 MHz spectrum from unwanted emissions from adjacent operations.² When recommending requirements for this adjacency and its potential for interference, Harris considered both the critical nature of communications in the 700 MHz public safety narrowband allocation and the potential harmful interference of adjacent dissimilar technologies. In this case, the adjacent dissimilar technologies – LTE cellular technology and noise limited non-cellular narrowband communication – pose significant threats to each other in regard to likely interference. To that end, Harris endorses the Commission’s proposal to include D Block service Rules in Part 90 to make a unified set of service rules for the entire expanded public safety broadband spectrum band. Additionally, the Commission should mitigate interference by making clear distinctions in type and rule parameter for the diverse mobile and base stations classes that will be used in this spectrum. Careful consideration should be given to using existing rule definitions and those created by 3GPP, albeit with modest changes where necessary to provide greater rule clarity.

Additionally, immediate matters, including setting equipment standards for early adopter operation in the expanded public safety broadband spectrum, must be established. Further, it is vital that unencumbered access to the expanded public safety broadband spectrum be afforded

² Harris uses in its comments the term “unwanted emissions” to refer to transmitter energy that is outside its spectrum allocation to avoid confusion with spurious and OOB terms that are commonly used to refer to specific parts of the frequency spectrum typically centered on but exclusive to the intended transmitter signal.

the licensee at the earliest stages and to the fullest extent feasible. To provide clarity for first responders and manufacturers alike, a clear recognition of the need for 700 MHz narrowband operation in the immediate future is vital.

Harris proposes key technical rules in its comments to further the goal of interference protection and focuses on the unique communication needs of public safety in this and adjacent bands.

Specifically, while use of the internal public safety guard band may serve the public interest at some point, it is essential that practical experience with actual operation of LTE in the extended public safety broadband spectrum be experienced and assessed first. Additionally, to enhance opportunities for rural deployment of the NPSBN, population density power limits should be replaced with maximum power limits that allow flexibility to maximize rural operation. Harris fully supports the Commission in its proposal to establish a 3 watt power limit for portable devices and the proposed power flux limit consolidation in this spectrum, considering the vital needs of public safety. Moreover, it appears evident that field strength limits to support deployment of more than one RAN are not needed in this spectrum.

Harris believes that, in aggregate, the proposals that follow provide a solid blueprint for rapidly deploying the NPSBN, protecting existing and future public safety communications in the 700 MHz band, and enhancing interference protection to public safety and commercial users of 700 MHz spectrum.

II. THE COMMISSION’S TECHNICAL SERVICE PARAMETERS MUST PROVIDE FIRSTNET AND COMMERCIAL STAKEHOLDERS WITH THE CLEAR GUIDANCE AND REGULATORY CERTAINTY THAT WILL DRIVE DEVELOPMENT OF AN INTEROPERABLE PUBLIC SAFETY NETWORK.

A. A Unified Set of Technical Requirements for the Expanded Public Safety Broadband Spectrum is Essential.

In this proceeding, the Commission seeks comment on establishing a unified set of technical service requirements for the expanded public safety broadband spectrum.³ As a threshold matter, Harris strongly supports unifying technical rules for the expanded public safety broadband spectrum, given that the formerly separated blocks of spectrum of which it comprises will be used in aggregate by first responders and others. This fact drives the need for harmonized rules to ensure spectral efficiency and minimize interference for first responders and other adjacent users.

Specifically, Harris agrees with the Commission’s initial proposal of removing the service rules for the D Block from Part 27 and placing them in Part 90.⁴ Part 27 rules include several parallel provisions unrelated to the expanded public safety broadband spectrum requirements and would be redundant and possibly confusing should the rules for the D Block section of the expanded public safety broadband spectrum be placed in this rule Part. Moreover, placing the D Block rules under Part 90 can ensure that all Band 14 mobile stations operating in the expanded public safety broadband spectrum operate under the same service rules.

³ See NPSBN Service Rules NPRM at ¶ 14.

⁴ See id. at ¶ 17.

B. The Commission Must Prioritize Adjacent Interference Protection.

The FCC has a unique opportunity to provide interference protection both from operations in the expanded public safety allocation upon other bands and from other bands upon the expanded public safety spectrum allocation. As the Commission develops protections for other bands, Harris believes that it should model its requirements on those rules the Commission already has in place that protect cellular operations that co-exist within a common geographic coverage area. To that end, Harris supports establishing in the expanded public safety broadband spectrum protections to other cellular bands from its operations consistent with rules in place for other cellular bands. Harris also supports adopting the emission limits established in Section 27.53(d)(3) for inclusion in 90.543.

It is also key to acknowledge the fact that this spectrum will primarily be used by our nation's first responders. The highest possible interference standards must be assigned to the expanded public safety broadband allocation to ensure its viability for providing critical communication services to first responders and those they serve.

Further, in planning for public safety use of the expanded public safety broadband spectrum, additional consideration should be given to the impact of and upon the public safety narrowband allocation from 769-775 and 799-805 MHz. Several factors drive this consideration. First, this band is used for critical public safety communications and will be for many years to come. Second, its use of non-cellular noise limited communication makes interference more likely from adjoining cellular systems. Third, unlike typical

cellular technology that can handover or roam when encountering poor channel quality or service, public safety narrowband voice communications have fewer options and frequently are assigned a channel rather than selecting a channel based on its interference conditions.

Finally, Section 6103 of the Middle Class Tax Relief and Job Creation Act of 2012 calls for reallocating the T-band spectrum (470-512 MHz).⁵ An implementation of this requirement will likely intensify the demand for licenses in the 700 MHz narrowband allocation. This additional demand will create a challenging spectrum management burden when managing inter-band interference. The 700 MHz narrowband allocation should not be further burdened by adjacent band interference that could effectively degrade narrowband channels that must co-exist with the expanded public safety broadband adjacent allocation.

III. THE COMMISSION MUST ADDRESS NEAR-TERM PUBLIC SAFETY ISSUES IN BOTH NARROWBAND AND BROADBAND SPECTRUM.

There are several issues that the Commission should examine as vital, near-term issues that will enhance first responder use of both narrowband and broadband public safety spectrum. Interim equipment rules for early build out must be established. Moreover, resolution on incumbent relocation must be decided swiftly and in a manner that expedites NPSBN build out. Finally, recognizing that narrowband operations are vital for first responders will clarify the landscape for users and manufacturers alike.

⁵ See Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156 (2012), §6103(a) (Spectrum Act).

A. The Commission Should Allow Equipment Certified Under the Waiver Order's Requirements To Operate on Early Build Out Systems In The Expanded Public Safety Broadband Spectrum.

The Commission faces a daunting task in this proceeding: rapidly establish comprehensive rules for the expanded public safety broadband spectrum that meet demanding interference protection needs of first responders. In the mean time, while the Commission has halted its acceptance and processing of any new equipment authorizations in this band⁶, FirstNet, as licensee of this spectrum, is negotiating agreements that will allow some jurisdictions to begin network operations as early build out of the NPSBN. However, the current regulatory framework does not support equipment availability to support these sub-licensed systems, as there has never existed service rules for the expanded band. Moreover, it is entirely possible that some first responders across this country will need to use broadband equipment and devices on the expanded public safety broadband spectrum before the Commission has had ample time to determine the ultimate path forward on service rules for the expanded public safety broadband spectrum.

Given these circumstances, and recognizing the importance of these early adopter projects and the imminent sub-licensing actions by FirstNet, Harris urges the Commission to one-again pro-actively enable these entities to procure equipment with

⁶ See NPSBN Service Rules NPRM at ¶ 14. The Commission had established technical requirements for equipment operating in the existing public safety 5 x 5 MHz broadband spectrum, and subsequent equipment certifications were granted to multiple equipment suppliers on that basis. See Requests for Waiver of Various Petitioners to Allow the Establishment of 700 MHz Interoperable Public Safety Wireless Broadband Networks, PS Docket 06-229, Order, 25 FCC Red 5145 (20 1 0) (Waiver Order).

suitable equipment authorizations. The most expedient path to this end is to permit equipment with existing authorizations already granted under the provisions of the Waiver Order and equipment subsequently certified to be compliant with the Waiver Order technical requirements to be authorized for use on these early adopter networks using the expanded public safety broadband allocation. Harris recommends the Commission implement this recommendation initially, as it continues to develop finalized rules and equipment certification requirements for this expanded band. Once these rules are finalized, all equipment operating on the expanded public safety broadband allocation, including those used in early deployments, should be subject to the new rules to ensure interoperability and multi-vendor environment.

B. The Public Safety Spectrum Act Obligates The Commission To Address All Issues Related To Incumbent Operations In The Affected Bands.

The Commission seeks comment on whether FirstNet should be responsible for the relocation of incumbent public safety narrowband systems that support mission-critical voice services in the affected bands.⁷

Harris believes that the Public Safety Spectrum Act requires the Commission to license the spectrum to FirstNet unencumbered, and that FirstNet should not be required to address incumbent operations. The statutory language of the Act is clear that the

⁷ See NPSBN Service Rules NPRM at ¶ 53.

Commission must take the necessary steps to reallocate and ready the spectrum for FirstNet's use.⁸

With respect to timing of the transition, Harris supports the Commission's call to establish a hard deadline by which relocation is accomplished. Setting a certain date for transition will enable FirstNet to deploy its nationwide service without the roadblock of incumbent operations and with increased regulatory certainty.

In regard to funding the relocation of incumbent narrowband operations, Harris believes it is best for Federal, State, and Local entities to address these transitions on a case-by-case basis without encumbering Part 90 rules with this responsibility.

C. 700 MHz Narrowband Spectrum Will Be Needed for Voice Communications For Years to Come.

The Commission seeks comment on allowing flexible use of the 700 MHz narrowband spectrum for broadband use.⁹ Harris believes that the 700 MHz public safety narrowband allocation will continue to serve first responders for their critical communications needs, and further believes that spectrum utilization will continue to grow in this band. As noted earlier, this band may be particularly important for potential relocation of some T-Band licensees. Encroachment of broadband signals into either the guard band or the

⁸ See Spectrum Act, §6201(a) ("The Commission shall reallocate and grant a license to the First Responder Network Authority for use of the 700 MHz D block spectrum and existing public safety broadband spectrum."). See also *id.* at §6201(c) of the Act (stating that the Commission "shall take all actions necessary to facilitate the transition of the existing public safety broadband spectrum to the First Responder Network Authority.").

⁹ See NPSBN Service Rules NPRM at ¶ 32.

narrowband allocation will create harmful interference and degrade the service reliability of this band and should not be permitted.

IV. A SET OF CLEARLY-DEFINED STATIONS AND CLASSES WILL ENSURE THE COMMISSION'S ABILITY TO DEVELOP A UNIFIED SET OF TECHNICAL RULES.

Given the technical complexities of developing and operating new technologies in the expanded public safety broadband spectrum, Harris believes the Commission should define unambiguously base station and mobile station classes; such separate definitions for use in these rules will simplify and clarify technical requirements and reduce the threat of interference. Use by the Commission of established, standard definitions and technical parameters where appropriate and available will drive sound rules and enhance protection interference.

A. The Commission Should Define Base Stations in Accordance with 3GPP Standards.

To maximize interference protection, the Commission must establish distinct definitions and rules for different types of base stations, all of which have different interference threats. The Commission should consider defining fixed base stations and deployable base stations (including cellular stations on wheels/light trucks and vehicular-mounted base stations) in a manner consistent with 3GPP definitions and technical specifications. In doing so, the Commission will create interference rules suitable for each distinct base station class that are consistent with the LTE standards and their continuing evolution.

Additionally, the Commission should consider adopting LTE base station classes as defined by 3GPP and shown in Table 1.¹⁰

**Table 1:
3GPP Base Station Classes**

Base Station Class	Max. Transmitter Power (dBm)	BS to MS minimum coupling loss (MCL) ¹¹ (dB)	BS to BS MCL (dB)
Wide Area	No limit ¹²	70	30
Medium Area	38	53	30
Local Area	24	45	45
Home	20	45	45

These base station classes were defined in part to address co-existence in an LTE environment where a tiering of base stations is anticipated to address coverage and capacity requirements. Wide area base stations, which provide most area coverage commercially, use antennas mounted above natural or manmade obstructions to provide extended coverage. Tower height ensures that mobile stations can generally only approach within a minimum distance to these sites. These sites use sectorized high gain antennas that enable strong interference potential between base station radios. Medium area base stations provide smaller area coverage particularly in urban settings where the antennas may be below building roof levels.

¹⁰ See 3GPP TS 36.104, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmissions and reception” (Release 11) March 2013.

¹¹ Minimum coupling loss is defined as the RF loss between equipment antenna ports and is applied whenever the modeled losses including antenna gain are calculated to be less than the MCL.

¹² While 3GPP does not have a limit for wide area base station transmitter power, 46 dBm is commonly used as a typical maximum transmitter power.

The lower elevation of these site antennas corresponds with the stronger minimum coupling loss (MCL) between Medium area sites and mobile stations corresponding to greater potential harmful interference. Local area base stations are designed to provide hot spot and filler sites to improve capacity or deal with a small difficult coverage area. These sites are used both outside and within buildings. Home base stations are designed to provide interior coverage in residential and small business environments. Minimum coupling losses for Local area and Home base stations are based on low gain site antennas and mobile stations approaching within 2 meters of these sites.

The parameters used by 3GPP to determine performance specifications for LTE transmitters form a strong basis for deriving requirements for protection of the 700 MHz public safety narrowband allocation. Moreover, separate technical requirements are needed for the base station classes to ensure that minimum technical requirements are placed on each of the classes while minimizing cost and harmful interference potential. Finally, deployable sites can be properly classified by one of the recommended base station classes and should be governed by technical requirements for that class.

B. Mobile and Immobile Station Definition Recommendations.

Beyond these 3GPP definitions, clarity should be further established on type and function of mobile stations. With regard to “portable devices,” Harris supports the Commission’s use of its existing definition of a portable device in Part 27.4. Pursuant to this definition, a portable device is a mobile station further distinguished by its transmission in proximity

to the user. Harris recommends inserting the definition as written in Part 27.4 into Part 90.7.

Additionally, Harris recommends that the Commission maintain the current definition of “mobile station” found in Part 90.7, but feels that it is important to clarify in the definition that a mobile station may be either mounted to a vehicle or carried. Moreover, mobile stations require separate consideration based on their maximum transmitter power and use.

Harris recommends that the commission consider separate requirements based on the mobile station 3GPP power class. 3GPP has recently defined a power class 1 UE (31 dBm) with corresponding technical requirements appropriate for its higher power level and potential for harmful interference. The commission should provide separate technical requirements for class 1 and class 3 mobile stations.

“Immobile stations” should be defined as a mobile station distinguished by its fixed location. Harris recommends that the definition of “control stations” in Part 90.542(a)(6) be used for such equipment, and that the name be replaced by “immobile stations” to more accurately portray the function of these mobile stations.

V. SPECIFIC RECOMMENDATIONS FOR TECHNICAL SERVICE RULES.

Harris greatly appreciates the detailed proposals set forth on technical service rules in this proceeding. Harris embraces much of the Commission’s vision in this regard, and offers the following input on key proposals.

A. The Public Safety Guard Band Evolution.

The Commission seeks input on whether technical rules established for the extended public safety broadband spectrum should be extended to the internal public safety guard band (768-769/798-799 MHz).¹³ As the Commission recognizes, the internal public safety broadband guard band (768-769/798-799 MHz) was designed to reduce interference between public safety narrowband and broadband operations, and that the risks identified upon this rule's promulgation have not dissipated. Thus, incorporating rules for the guard band would be premature; the existing expanded public safety broadband allocation should be deployed and subsequent evaluation of real-world harmful interference should be evaluated before the guard band is allowed to be used. Harris envisions that future rules for the guard band might include provisions for a gradual transition of the guard band and parts of the current 700 MHz public safety narrowband allocation to broadband use - should observations from practical operation of adjacent broadband and narrowband operations merit such action.

B. Power Limits Should Not Be Governed By Population Density.

The Commission proposes county-level population density thresholds in Section 90.542(a), and seeks comment whether they are appropriate.¹⁴ The Commission's ERP rules have historically been an essential tool in managing interference between spectrum users. This tool should afford flexibility to the extent possible while preventing harmful interference to other spectrum users. Since the

¹³ See NPSBN Service Rules NPRM at ¶ 31.

¹⁴ See *id.* at ¶ 19.

expanded public safety broadband spectrum will be managed by a single entity, that entity should be responsible for intra-band interference management. Harris believes that broadband public safety services will be deployed in rural areas where cost effectiveness will call for maximizing coverage from each deployed site. Harris therefore contends that reducing ERP as a function of antenna height as proposed in §90.542(a)(8) may not reflect the economic realities of building out the NPSBN in rural areas. Harris recommends striking provisions for low population density areas and ERP limits as a function of antenna height. Flexibility should be allowed for implementation of a cost effective network compliant with FCC regulation, but free of rules that may force higher site densities based on regulation rather than need.

Harris contends that a single set of maximum power limits should be established and the licensee should be offered flexibility to determine specific operating parameters for each RF site consistent with its RF planning and network design activities and subject to the single limit established by the Commission.

C. Portable Device Power Limits Higher Than Those Established For Commercial LTE are Appropriate.

Harris supports the Commission's proposal establishing a 3 watt power limit for portable devices.¹⁵ This level, while higher than commercial practice, will allow flexibility for device use that will benefit first responders in rural areas, where signal strength is vital.

¹⁵ See id. at ¶ 20.

Release 11 of 3GPP standards introduced a class 1 LTE UE for the expanded public safety broadband allocation. The devices referred to as high power user equipment (HP-UE) in the 3GPP standards allow transmitter power with 31 dBm (+2/-3 dB) average power.¹⁶ This higher power classification recognizes the unique needs of the public safety community for coverage extension beyond Class 3 device power. Substantial work was devoted to evaluating the potential for additional interference associated with the HP-UE. Technical performance standards for the HP-UE were increased to ensure that it would not burden its own networks or adjacent bands with significant interference. In particular, unwanted emission requirements for the HP-UE were increased to ensure that it would not affect frequency adjacent LTE uplinks by more than 0.5%. The current 3 watt power limit for portable devices provides FirstNet with the flexibility to define higher power devices as required for public safety's unique requirements.

In developing requirements for direct mobile station-to-mobile station communications, identified as a core requirement for public safety operations, 3GPP has determined that mobile stations with more than 23 dBm power may be necessary to provide sufficient usable range.¹⁷ The commission should provide FirstNet the flexibility to adopt future 3GPP standards that support higher transmitter power by leaving the portable device power at 3 watts.

¹⁶ See 3GPP TS 36.101, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmissions and reception." (Release 11) March 2013.

¹⁷ See 3GPP, Draft Report of 3GPP TSG RAN WG1 #72bis v0.1.0 Section 7.2.7 Chicago, USA, April 2013.

D. Harris Supports the Proposed Power Flux Limit Consolidation.

As noted above, Harris agrees with the commission's proposal to consolidate the expanded public safety allocation into a single Part 90 provision.¹⁸ Power flux density is a direct measure of the signal strength that may be captured by a mobile station antenna and is therefore the appropriate metric for evaluating interference potential of a locally transmitted signal. Consistent with the Commission's mission to protect band allocations from causing harmful interference to their neighboring allocations, the power flux density threshold currently set in §90.542(b) is consistent with other cellular technologies that are regulated by §27.55(c) within the 700 MHz band and therefore appropriate by offering equivalent protection to adjoining commercial bands from public safety transmissions.

However, Harris notes that the power flux density maximum allowed by §27.55(c) can be expected to force a public safety mobile station to handover into a non-public safety dedicated band or roam when power flux densities in adjoining frequencies approach protection levels. This behavior can be anticipated because: 1) The power flux density levels allow practical antennas to intercepted signals that are stronger than the 3GPP specified level of -25 dBm for the maximum desired signal; and 2) When subject to power flux density limits from adjoining allocations, a UE will frequently not have the ability to reject this signal and still process a typically much weaker desired signal.

To minimize undesired roaming due to strong signals, Harris recommends that the commission remove §90.542(a)(5). Harris believes that exempting sites with an ERP

¹⁸ See NPSBN Service Rules NPRM at ¶ 21.

below 1000 watts from a power flux density requirement is counterproductive to minimizing harmful interference. Signal levels above the current threshold are likely to create problems for receivers and these levels are determined not by the ERP, but by a combined effect of the site antenna directivity and ERP. By example, a low profile site, with 100 watts ERP, and strong down tilt could also create harmful interference zones that exceed the flux density limitation, but this site would currently be exempted from this provision. Further, Harris reviewed comparable regulations in §27.55 and found no similar exemption for sites under 1 kWatt ERP. Based upon this evaluation, Harris concluded that the Commission prevents high flux density zones consistent with its interoperability directive that multiple manufacturer mobile stations should be able to operate in coverage areas.

The Commission should also consider the potential for interference to current narrowband operations in the 769-775 MHz band and how these operations could be harmed by not regulating high flux densities at all ERP levels. While best practices in system design and deployment call for co-sites that include transmitters for both narrowband operations at 769-775 MHz and broadband operations at 758-768 MHz to minimize interference between systems, co-sites will not be possible in all situations. In particular, site densities for LTE are expected to be higher necessitating the need for broadband-only sites. Narrowband mobile stations near a broadband-only site are subject to strong broadband signals and relatively weak signals from their serving narrowband site. Industry best practice for narrowband mobile stations call for exceptional blocking

characteristics, however without limits on power flux density LTE sites could become narrowband interference zones.

E. Emission Limits Should Be Consolidated and Carefully Designed Around Unique Interference Concerns in This Band.

Out of band emission limits protecting the 700 MHz public safety narrowband spectrum (769-775/799-805 MHz) require special attention by the commission. Consistent with other proposals of the Commission, rules in §27.53(f) should be consolidated with the rules in §90.543(f). In considering these rule changes, the Commission should evaluate the ability of the current rules to protect narrowband spectrum from LTE transmitters operating in the expanded public safety broadband spectrum and provide flexibility for manufacturers and licensees to obtain equipment authorizations for standard base stations and additional equipment that may be required to meet unwanted emissions required to maintain critical communication reliability in the 700 MHz public safety narrowband allocation. This band allocation adjacency requires special consideration because: 1) Broadband cellular interference-limited technology is adjacent to non-cellular noise limited technology (the challenges of these adjacencies are well documented in the 800 MHz Band Reconfiguration)¹⁹; 2) The 700 MHz public safety narrowband allocation is used for existing critical communications and inadequate commission regulation could seriously degrade the performance of these existing networks; and 3) Section 6103 of the Middle Class Tax Relief and Job Creation Act of 2012 calls for reallocating the T-band

¹⁹ <http://transition.fcc.gov/pshs/public-safety-spectrum/800-MHz/reconfiguration.html>.

spectrum (470-512 MHz.) An implementation of this act will likely intensify the demand for licenses in the 700 MHz narrowband allocation.

In considering emission limits for base stations and mobile stations, Harris has used RF models endorsed by 3GPP to evaluate interference and adjusted these models as appropriate to reflect differing technologies and equipment deployed in public safety networks. Harmful interference occurs when transmitters and receivers are tuned to adjacent channels or bands and are in close proximity. In recognizing the inherent variability of RF losses between mobile stations and base stations that are in relative proximity, 3GPP has adopted the practice of defining MCL (minimum coupling loss.) for its analysis and simulations. As such, it limits worse case RF coupling to a minimum amount, reflecting reasonable scenario assumptions, but not necessarily worst case conditions. Harris believes the MCL provides a good balance between worst case conditions and allowing too much interference for public safety wireless systems.

Table 2 consolidates derived requirements for unwanted emissions based on Station Class, the susceptible receiver band, and the applicable Δ MCL. Adjustments to applicable 3GPP scenario MCL's in Table 1 to correspond with the mixed technology scenario shown in Table 2 are given as Δ MCL. While many of these recommended requirements exceed the current regulations provided by the FCC, the methodology is based on 3GPP standard practice for evaluating co-existence and co-location in commercial deployments. Harris feels that these bands at least require this level of protection. A more detailed analysis showing parameters and calculations for these recommended unwanted emission levels is provided in Appendix A. In advocating for

these tougher requirements, Harris is specifically recommending requirements that must be met by the deployed site (using auxiliary equipment as needed) and not necessarily required of commercially available base stations. By recommending this approach Harris is recognizing that leveraging standard commercial equipment is a cost effective way to deploy a nationwide network, but that the critical nature of these allocations require adequate protections.

**Table 2:
Protection Recommendations**

Station Class	Victim Receiver	Δ MCL (dB)	Unwanted Emission
Wide Area Base Medium Area Base Local Area Base Home Base	Narrowband Base Station (799- 805 MHz)	4 0	-104 dBm/6.25kHz -93 dBm/6.25kHz
Wide Area Base Medium Area Base Local Area Base Home Base	Narrow Band Mobile Station (769-775 MHz)	-5	-65 dBm/6.25kHz -81 dBm/6.25kHz -89 dBm/6.25kHz -89 dBm/6.25kHz
Narrow Band Base Station	Wide Area Base Medium Area Base Local Area Base Home Base (788-798 MHz)	4 0	-92 dBm/100kHz -81 dBm/100kHz
BB Mobile Station	Narrow Band Base Station (799-805 MHz)	4	-57 dBm/6.25 kHz ²⁰

F. Field Strength Limits

The Commission seeks input on whether to set field strength limits for the expanded public safety broadband.²¹ Field strength limits to support deployment of more than one RAN are not

²⁰ Requirement for mobile stations when operating below 11 dBm transmitter power.

²¹ See NPSBN Service Rules NPRM at ¶ 26.

necessary for this spectrum. Although multiple physical/ jurisdictional RANs may be deployed, they need to function logically as a single RAN, including support for handover across these RANs, in accordance with normal cellular operations. RAN design flexibility will be needed to ensure proper operation of a multiple-RAN environment, and the licensee should determine field strength limits for all Band 14 RAN deployments to ensure proper cellular operation and these limits.

VI. CONCLUSION

For the foregoing reasons, Harris urges the Commission to consider its recommendations as it considers issuing rules pursuant to this proceeding.

Respectfully submitted,

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Addendum A

This Addendum provides a detailed basis for the derived unwanted emission recommended requirements for co-location and co-existence of the adjacent public safety 700 MHz narrowband and broadband allocations. In calculating these recommended requirements, Harris used methodology developed by 3GPP to calculate necessary transmitter unwanted emissions in co-location and co-existence scenarios for commercial deployments. Public safety bands should be provided at least this level of protection.

A detailed explanation of the interference scenarios is provided for the Wide Area Base Station, while Table 2 provides a summary of the recommendations for each of the Base Station classes.

A description of each scenario is given below along with the necessary parameters and calculations.

Co-located wide area sites (narrowband and broadband base stations in proximity)- For these scenarios, broadband and narrowband site equipment are in relative proximity - in some instances, via a shared tower, and in other cases, via towers that are nearby and in “line of sight.”

- Scenario 1: Site Compatibility: 700 MHz Broadband Base Transmitter Interference into Narrowband Base Receivers – 3GPP in recognizing the potential for interference between base stations refers to this scenario as base station co-location. Specific to this use case a broadband base site’s unwanted emissions causes interference to a narrowband uplink base station receiver. In evaluating requirements for co-location 3GPP used the following parameters:

- 5 dB noise figure base receiver, 0.8 dB desense allowance for the base receiver, and 30 dB minimum RF coupling loss (MCL) between the interfering transmitter and the victim receiver²². For interference to narrowband operations the MCL can be appropriately raised to 34 dB, because the sector antenna that is generally used in the cellular scenario is replaced by an omni-directional antenna for narrowband operations. A typical sector antenna is 13 dBi while an omni-directional antenna used for narrowband would typically be 9 dBi.
- $\text{Unwanted emissions} = 10\log(kT) + 10\log(BW) + NF + 10\log(10^{(\text{desense}/10)} - 1) + \text{MCL}$
- $-104 \text{ dBm} / 6.25 \text{ kHz} = -174 + 38.0 + 5 - 7 + 34$

²²See 3GPP TR 36.942, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Frequency (RF) system scenarios” (Release 11) September 2012.

- Consistent with the commission's duties to protect the narrowband public safety spectrum (799-805 MHz) and recognizing that co-siting public safety narrowband and broadband operations provide reductions in co-existence interference between these systems, Harris recommends that the commission consider adding a requirement that expanded public safety broadband spectrum transmitters should be required to have spectral energy below -104 dBm/ 6.25 kHz in the public safety narrowband allocation (799-805 MHz.)
 - Harris believes that the additional costs associated with meeting this requirement are minimal. This requirement also recognizes that co-siting is a likely common deployment scenario for public safety broadband and narrowband operations. Furthermore this requirement ensures that FirstNet can consider multiple vendors with assurance that its vendor selections are compatible with adjacent public safety narrowband operations.
- Scenario 2: Narrowband mobile station operation – Narrowband receiver operation near an expanded public safety broadband base station transmitter is subject to unwanted emissions from that site. Using the following parameters: a narrowband mobile station that accepts 3 dB of desense, has a 6 dB noise figure, and an MCL of 65 dB²³ a protection requirement can be derived. In this scenario narrowband mobile station reception is desensed by broadband base station unwanted emissions.
- Unwanted emissions = $10\log(kT) + 10\log(BW) + NF + 10\log(10^{(desense/10)} - 1) + MCL$
 - $-65 \text{ dBm/ } 6.25 \text{ kHz} = -174 + 38 + 6 + 0 + 65$
 - Current regulations require that the base station has unwanted emissions that are below -46 dBm/ 6.25 kHz. The derived requirement is 19 dB more difficult allowing for a 3 dB desense of the narrowband public safety mobile station.
 - Harris recommends that the commission consider increasing the requirement for protection of public safety narrowband operations near a broadband site with the following requirement:

²³ An MCL of 65 dB (70 dB -5 dB) reflects the difference in antenna efficiencies (5 dB) between a typical integrated cellular antenna and an external antenna typically found on public safety mobile stations.

- An expanded public safety broadband base site shall generate unwanted emissions less than -65 dBm/ 6.25 kHz within the public safety narrowband downlink allocation (769-775 MHz.)
- Harris believes that the additional costs associated with this verification are minimal. Only FirstNet approved broadband base station equipment vendors are required to pass this test and only a few potential vendors exist. This test also recognizes that public safety broadband only sites will be required to provide continuous coverage for broadband services and that narrowband coverage around these sites will be essential to maintaining critical communications in the narrowband allocation. Additionally this test ensures that FirstNet can consider multiple vendors with assurance that its vendor selections are compatible with adjacent public safety narrowband operations.
 - Broadband mobile station network operations are not anticipated to create interference around their serving sites.
- Scenario 3: Proximity narrowband mobile station operation – No problems are anticipated for 700 MHz narrowband mobile transmitters operating near expanded public safety 700 MHz broadband sites.
- Scenario 4: Proximity broadband mobile station operation – At a co-located site, a nearby broadband mobile station’s unwanted emissions will be intercepted by a narrowband base station receiver. Allowing for 3 dB of desense, a 5 dB noise figure, and an MCL of 74 dB. In this scenario narrowband mobile station transmissions are received by a base station receiver that is desensed by broadband transmissions.
 - Unwanted emissions= $10\log(kT) + 10\log(BW) + NF + 10\log(10^{(desense/10)} - 1) + MCL$
 - -57 dBm/ 6.25 kHz = -174 + 38 + 5 + 0 + 74
 - Current regulations require that a mobile station have unwanted emissions that are below -35 dBm/ 6.25 kHz. The derived requirement is 21 dB more difficult. As a practical matter a broadband mobile station near its serving base station will back-off its transmitter power and although no regulation applies will likely generate lower unwanted emissions. In not specifying a performance requirement the commission risks approving equipment that will cause harmful interference to public safety narrowband base station receivers due to excessive unwanted emissions even with lower transmitter power.

- 3GPP has previously addressed similar issues cost effectively. By comparison NS_07 signaling was introduced into band 13 UE requirements²⁴ to protect the adjacent narrowband allocation downlink from unwanted emissions produced by the band 13 UE transmitter. In this instance, a B13 UE when commanded with the NS_07 signal must meet a much tougher standard for unwanted emissions. To achieve this requirement the UE is allowed to lower its maximum transmitter power which allows the mobile station transmitter to operate more linearly and generate less unwanted emissions. Extensive studies were performed to understand the current capabilities of cell phones to meet tougher unwanted emissions specifications without adding complexity/ cost to the UE. The NS_07 requirement allows transmitter power reduction as high as 12 dB to meet a -57 dBm/ 6.25 kHz unwanted emissions requirement in the adjacent public safety narrowband downlink allocation.
- Harris recommends that the commission considering providing protection to the narrow band base station receiver via the following requirement:
 - An expanded public safety broadband mobile station when operating at power levels lower than 11 dBm must achieve an unwanted emissions level less than -57 dBm/ 6.25 kHz within the 700 MHz public safety narrow band uplink allocation (799 - 805 MHz.)
 - The lower transmitter power level recognizes that this interference problem occurs when an expanded public safety broadband mobile station is in proximity to a narrowband base station receiver, but that co-siting the broadband base station ensures that the broadband mobile station will back-off its power.

Scenarios associated with 700 MHz public safety broadband only sites.

- Scenario 5: Site compatibility – N/A
- Scenario 6: Site Compatibility: 700 MHz Narrowband Base Transmitter Interference into Broadband Base Receivers - Similar to the previous example, the following analysis is applied to evaluating acceptable unwanted emissions into an expanded public safety broadband base station receiver.

²⁴ See 3GPP TS 36.101, “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmissions and reception” (Release 11) March 2013.

- Unwanted emissions = $10\log(kT) + 10\log(BW) + NF + 10\log(10^{(\text{desense}/10)} - 1) + \text{MCL}$
- $-92 \text{ dBm} / 100 \text{ kHz} = -174 + 50.0 + 5 - 7 + 34$
- To protect the broadband operation from operation of narrowband transmitters requires that the aggregated unwanted emissions from all transmitters operating in the 700 MHz public safety narrow band allocation are below: $-92 \text{ dBm} / 100 \text{ kHz}$. Harris recommends that the commission consider providing aggregated noise limits in the 788 – 798 MHz range.

Scenarios associated with 700 MHz public safety narrowband only sites.(not recommended for deployment due to increased inter-band interference)

Scenario 7: Site compatibility- N/A

- Scenario 8: Narrowband mobile station operation – are not anticipated to create interference around their serving sites.
- Scenario 9: Broadband mobile station operation – Narrowband public safety only sites are not a preferred configuration for geographic areas with public safety broadband and narrowband operations. However, if deployed a broadband mobile station transmitter unwanted emissions can interfere with the narrowband base station uplink receiver. The broadband mobile station to base station MCL is 74 dB, allowing for 3 dB desense and a noise figure of 5 dB.
 - unwanted emissions = $10\log(kT) + 10\log(BW) + NF + 10\log(10^{(\text{desense}/10)} - 1) + \text{MCL}$
 - $-57 \text{ dBm} / 6.25 \text{ kHz} = -174 + 38 + 5 + 0 + 74$
 - Current regulations require that a mobile station have unwanted emissions that are below $-35 \text{ dBm} / 6.25 \text{ kHz}$. The derived requirement is 21 dB more difficult.
 - However, co-siting of broadband and narrowband sites eliminates this issue. Harris therefore does not recommend changing regulatory requirements for this scenario. An instead advocates best practice deployment practices that avoid narrowband only sites.

Consolidated Recommended Rules for Base Station Classes – In providing the preceding analysis Harris considered requirements for wide area broadband base stations without considering the additional LTE base station classes. Table 2 provides a consolidated set of requirements by station classes to reflect the varied environments anticipated for these equipment classes. The

calculation for the additional LTE base station classes is similar except that the MCL used is based on summing the applicable MCL from Table 1 and the Δ MCL from Table 2.